REMARKS

Claim 29 has been amended to incorporate the recitations of claim 36, and claim 36 has been canceled accordingly. Claim 49 has been amended as suggested by the Examiner. Other claims have been amended or canceled in view of the amendment of claim 29.

The specification has been amended to correct an inadvertent error which can be seen when considered in context.

In this regard, Applicants note that from the description appearing on page 24, lines 9 to 14, Comparative Example 2 is compared with Examples 3 and 4, which have such construction that the blue light-emitting material, the green light-emitting material and the red light-emitting material are respectively included in separate layers. Thus, it is natural to consider that Comparative Example 2 also has the foregoing construction.

The emission peak wavelength of blue in Comparative Example 2 is 482 nm. Thus, it is natural to consider that Comparative Example 2 rather uses the same blue light-emitting material as those of Example 3 (482 nm) and Example 4 (485 nm) than the blue light-emitting material having an emission peak wavelength of blue of 450 nm in Examples 1 and 2, and Comparative Example 1, each having the blue light-emitting material, the green light-emitting material and the red light-emitting material in the same layer. The blue light-emitting material in Examples 1 and 2, and Comparative Example 1 is 1,1,4,4-tetraphenylbutadiene (refer to page 20, line 1). The blue light-emitting material in Examples 3 and 4 is 1-[3,5-di(1-phenyl)-phenyl]pyrene (refer to page 22, line 6).

Entry of the above amendment is respectfully requested.

Anticipation Rejection

On page 2 of the Office Action, in paragraph 4, claims 29, 33-35 and 49 are rejected under 35 U.S.C. 102(e) as being anticipated by Forrest et al. (US 6,310,360 B1).

In response, Applicants note that independent claim 29 has been amended to incorporate the recitations of claim 36, which was not included in this rejection. Accordingly, Applicants submit that this rejection has been overcome, and withdrawal of this rejection is respectfully requested.

Obviousness Rejections

On page 4 of the Office Action, in paragraph 6, claims 29 and 33-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al. (US 6,310,360 Bl) as applied to claims 29, 33-35 and 49 above, and further in view of Egusa et al. (US 5,294,810) and either one of Igarashi et al. (US 2001/0019782 Al) or Thompson et al. (US 2002/0034656 Al). On page 7 of the Office Action, in paragraph 7, claims 29 and 33-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baldo et al. in *Appl. Phys. Lett.* 75(1), pp. 4-6 (July 5, 1999), in view of Egusa et al. (US 5,294,810) and either one of Igarashi et al. (US 2001/0019782 Al) or Thompson et al. (US 2002/0034656 Al).

In response, Applicants submit initially that the present invention is different from Forrest et al in the functional mechanism, as explained below. According to such explanation, Applicants submit that since the invention of the present application is different from the cited reference not only in the construction but also in the functional mechanism, the invention of the present application is not obvious from the cited reference. Further, Applicants submit that the

present invention is not obvious because it provides unexpectedly superior results, as can be seen from the executed Declaration submitted herewith and as discussed below.

In particular, as set forth in the Declaration, a comparison of the invention of the present application and that of the cited reference Forrest et al. is as follows.

1. The construction of light-emitting part

In the present invention, respective light-emitting layers of blue, green and red are laminated to form a three-layered construction. Alternatively, the present invention has such a construction that light-emitting materials of blue, green and red are mixed together in the same layer. In contrast, Forrest et al. has a two-layered construction comprising a sensitizer layer and a red light-emitting layer.

In Forrest et al., the thickness of the sensitizer layer is 1 nm and that of the red light-emitting layer is 1 nm. These layers form an ultra thin film (it cannot be confirmed that these layers form a film), and these layers are repeated five times to provide the thickness of 10 nm in total.

The reason why Forrest et al. has the foregoing construction is derived from the difference in the light emission mechanism, which will be described below. This is a noticeable characteristic.

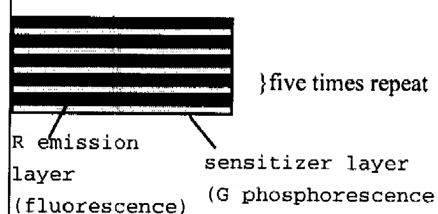
2. Material to be used in light-emitting part

The present invention resides in a case where for a green light-emitting layer (hereinafter referred to as G emission layer), a phosphorescent material is used, and for a red light-emitting layer (hereinafter referred to as R emission layer), a phosphorescent material is also used. This case is most excellent in light emission luminance and light emission efficiency.

In contrast, in Forrest et al., although a G emission layer comprises a phosphorescent material (sensitizer), a R emission layer comprises a fluorescent material.

The reason why Forrest et al. uses the R fluorescent material is derived from the difference in the light emission mechanism that will be described below. The employment of the R fluorescent material is also a noticeable characteristic.

Table 1

	Invention of present application	Forrest et al. (US Patent 6,310,360)
Emission layer construction	B emission layer/G emission layer/R emission layer (three-layered construction [refer to the following] or B/G/R in one layer) R emission layer (phosphorescence or fluorescence) G emission layer (phosphorescence) B emission layer (phosphorescence or fluorescence)	sensitizer layer/R emission layer (two-layered construction) five times repletion in each layer thickness of 1 nm (10 nm in total) 
Materials used	B emission layer: host + emission material (phosphorescence or fluorescence) G emission layer : host + emission material (phosphorescence) R emission layer : host + emission material (phosphorescence)	sensitizer layer : host + phosphorescent material R emission layer : host + fluorescent material
R emission mechanism	(1)host in R emission layer→phosphorescent emission by energy transfer to emission material T1 (2)T1(G) from G emission layer to R emission layer →phosphorescent emission by energy transfer to T1(R)	(3)T1 (phosphorescent material) in sensitizer layer→fluorescent emission by ISC energy transfer to S1(R) (4)S1 (host or emission material) in sensitizer layer→fluorescent emission by energy transfer to S1(R)

3. Emission mechanism

In the present application, emission occurs mainly according to the following two mechanisms.

(1) In the R emission layer, excitons (S1, T1) are generated in the host, and these excitons are energy-transferred to the R emission material so that phosphorescent emission may occur from T1(R).

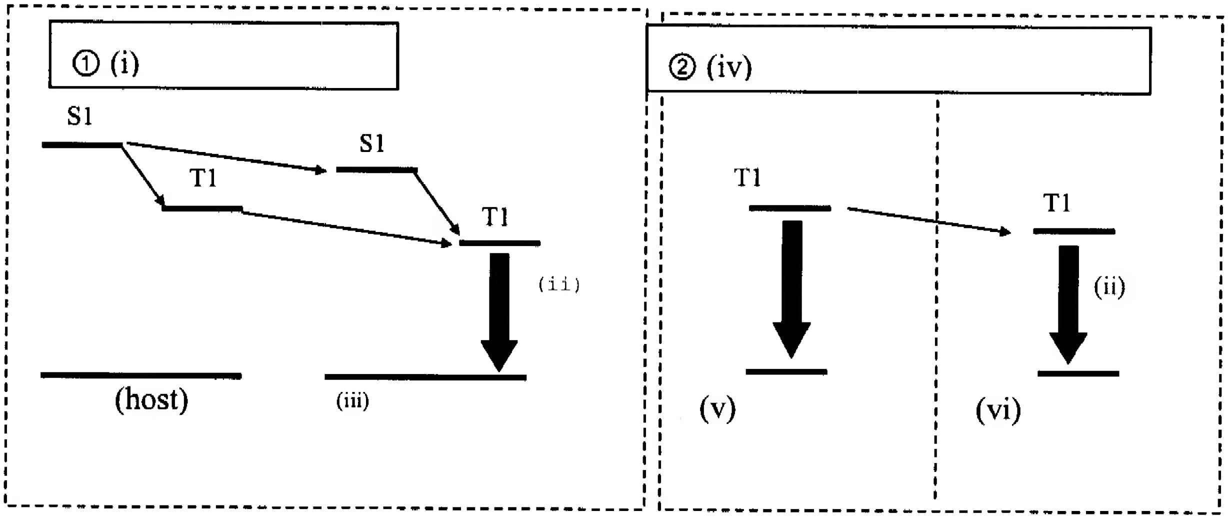
Host S1→emission material S1→ emission material T1→ phosphorescent emission

Host T1→emission material T1→ phosphorescent emission

(2) Exciton T1 in the G emission layer is energy-transferred to the R emission layer T1(R) so that phosphorescent emission may occur.

Because of the functioning of both of the above-described (1) and (2) as emission mechanisms, in the case of G phosphorescence and R phosphorescence, extremely high emission luminance and emission efficiency can be realized by contacting both in the present invention.

Since the life of the T1 exciton is long (1 to 2 μ seconds), the T1 exciton can migrate through the R emission layer (~ 10 nm). Therefore, when the thickness of the R emission is designed thick, further increased emission efficiency can be obtained.



(i) emission mechanism in R emission layer

(ii) R emission

(iii) R phosphorescent material

(iv) T1 energy transfer from G emission layer to R emission layer

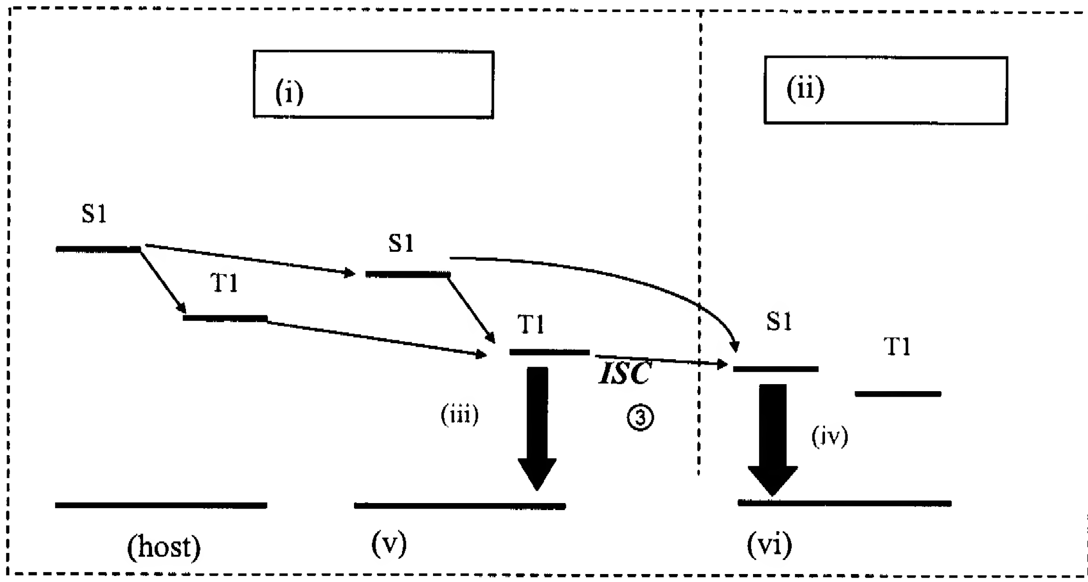
(v) G phosphorescent material

(vi) R phosphorescent material

In contrast, in Forrest et al., as described in Fig. 1 of the specification, energy is transferred from T1 in the sensitizer to S1 in the R fluorescent material (ISC: intersystem crossing) to emit fluorescence from S1(R) (mechanism ③ shown in the following figure).

S1 exciton (singlet) generated in the R emission layer is short in its life (1 to 10 n seconds). Thus, it hardly migrates through the emission layer and emits around the interface. For this reason, the thinner the thickness of the R emission layer is, the higher is the emission efficiency. Therefore, the thickness of the R emission layer is designed to be thin, i.e., 1 nm. In order to further elevate the ISC efficiency, (sensitizer layer/ R emission layer) is repeated five

times. Thus, the construction of Forrest et al. is completely different from that of the present application.



(i) sensitizer layer

(ii) R fluorescent layer

(iii) G emission

(iv) R emission

(v) G phosphorescent material

(vi) R fluorescent material

In the Comparative Example in the Declaration, the devices of (3) and (4) described below were produced according to the same manner as in Example 1 of the specification of the present application except for changing the construction of the device as set forth below, and measured according to the same manner as in Example 1 and evaluated.

The results are shown in Table 2 together with Examples 1 to 4 of the present application,

Comparative Examples 1 and 2 and additional Comparative Examples 1 and 2 submitted previously.

(3) Additional Comparative Example 3

polyvinyl carbazole/bis(2-phenyl quinoline)acetylacetonato iridium complex (red phosphorescent material)/2-(4-biphenyl)-5-(4-t-butylphenyl)-1,3,4-oxadiazole (electron transfer material) = 200/6/50

(4) Additional Comparative Example 4

polyvinyl carbazole /4-(dicyanomethylene)-2-methyl-6-(4-dimethylamino styryl)-4H pyrane (red fluorescent material)/ 2-(4-biphenyl)-5-(4-t-butylphenyl)-1,3,4-oxadiazole (electron transfer material) = 200/6/50

Table 2

	Green Light-emitting Material	Red Light-emitting Material	Lmax (Cd/m^2)	Vmax (V)	P (Cd/A)	Light-emitting Wavelength Peak
Example 1	**Phosphorescent**	Fluorescent	23000	11	18	450, 515, 604
Example 2	**Phosphorescent**	**Phosphorescent**	38000	10	25	450, 515, 599
Example 3	**Phosphorescent**	Fluorescent	56000	11	38	482, 515, 604
Example 4	**Phosphorescent**	**Phosphorescent**	78000	10	45	485, 515, 600
Comparative Example 1	Fluorescent	Fluorescent	2400	14	1.5	450, 520, 603
Comparative Example 2	Fluorescent	**Phosphorescent**	5200	14	2.5	482, 516, 605
Additional Comparative Example 1	**Phosphorescent**	*None*	32000	11	25	515
Additional Comparative Example 2	Fluorescent	*None*	23000	15	1.8	520
Additional Comparative Example 3	*None*	**Phosphorescent**	5800	15	3.3	599
Additional Comparative Example 4	*None*	Fluorescent	12800	14	4.0	604

In G fluorescence, R fluorescence (Comparative Example 1), a triplet exciton cannot be used for emission, which inevitably results in a low emission efficiency and a small emission luminance.

In contrast, in G fluorescence, R phosphorescence (Comparative Example 2), exciton energy cannot be transferred from G fluorescence to R phosphorescence, which inevitably results in a low emission efficiency and a small emission luminance.

When Additional Comparative Example 3 is compared with Additional Comparative Example 4, Additional Comparative Example 3 using a phosphorescent red light-emitting material is inferior to Additional Comparative Example 4 using a fluorescent material in Lmax (maximum luminance) and P (emission efficiency). This is because triplet exciton energy cannot be transferred efficiently from polyvinyl carbazole, which is a host material, to a red phosphorescent red material.

In contrast, in Example 2 and Example 4, a phosphorescent green light-emitting material is added and triplet exciton energy transfer having the route of polyvinyl carbazole→ phosphorescent green light-emitting material→ phosphorescent red light-emitting material effectively occurs so that an emission device showing a high emission efficiency and a high emission luminance can be obtained.

This is an excellent effect that cannot be expected from Forrest et al. having a different emission mechanism from that of the present invention.

In view of the above, the Declarant concludes that the present invention provides unexpectedly superior results.

With respect to Baldo and Egusa in particular, Applicant refers the Examiner to the comments previously provided regarding those references.

Finally, Applicants note that in Igarashi et al and Thompson, a red light-emitting orthometallated complex is disclosed. However, these references do not include any description suggesting the mechanism to achieve a high luminance by the triplet energy transfer: from host to a green light-emitting material, and then from the green light-emitting material to a red light-emitting material.

Thus, Applicants submit that the present invention is not obvious over the cited art combinations, and withdrawal of the rejections is respectfully requested.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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